J. LYMAN.

Protracting Trigonometers.

No. 149,590. Patented April 14, 1874.

Fig. 8.

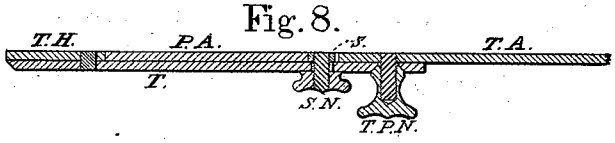


Fig. 6.

Fig. 4.

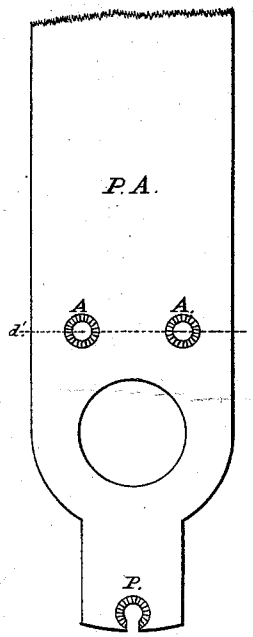


Fig. 9.

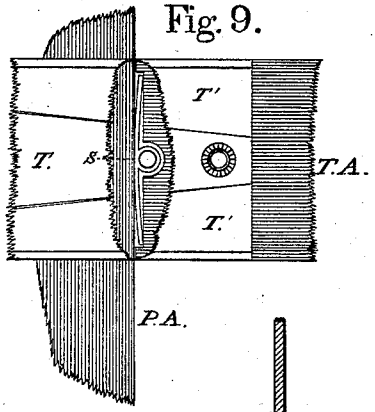


Fig. 5.

Fig. 7.

Fig. 1.

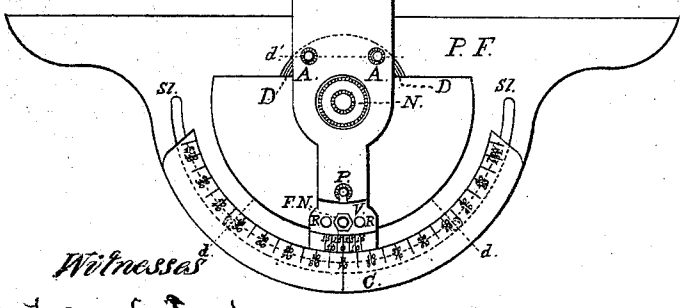


Fig. 3.

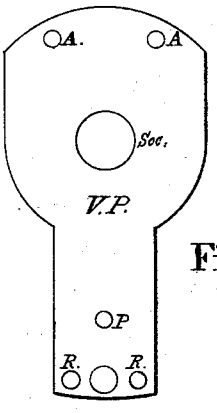
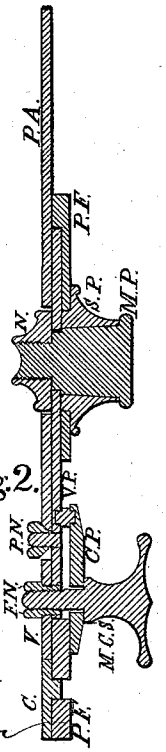


Fig. 2.



Witnesses

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IMPROVEMENT IN PROTRACTING TRIGONOMETERS.

Specification forming part of Letters Patent No. **149,590**, dated April 14. 1874; application filed December 5, 1872.

To all whom it may concern:

Be it known that I, JOSIAH LYMAN, of Lenox, in the county of Berkshire, in the State of Massachusetts, have invented a new and Improved Drafting-Instrument, which I call Improved Protracting Trigonometer; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings and to the letters of reference marked thereon.

My invention consists, first, in the substitution of a sliding graduated arc in the trigonometer instead of the same fixed, and so arranged that it may be instantly shifted forty-five degrees, or less, to right or left, at the pleasure of the operator, thus enabling him to make any side of his drawing which he may find the most convenient, either parallel or at right angles with his drafting-board; secondly, in so connecting, with the arm of the protractor, a sliding T that it shall both take the place of the end borders of the board, and enable him who uses it to lay down upon paper two distances at right angles to each other at the same time without changing the instrument, and at any desired angle; thirdly, in such an attachment of the arms of both the protractor and of the sliding T that each is susceptible of nice adjustment, including the peculiar manner of adjustment.

To enable others skilled in the art to comprehend and use my invention I will describe in detail its construction, manner of working, and applications.

Figure 1 presents a bird's-eye view of the instrument on a scale of one-half linear size, and in exact proportions, except that the protractor and T-arms are represented as broken off for lack of space. All the other figures are of full and exact size. Fig. 2 is a longitudinal section of the base, with its frame, plates, pivots, nuts, graduated arc, vernier, &c., and Fig. 8 the same section of the sliding T in its normal position on the protractor-arm, except that, by mistake, it is drawn inverted. Fig. 3 represents the vernier-plate, separate from the instrument, with its several orifices. Fig. 4 shows the attached end of the protractor-arm, also separate from the instrument, with the pivot-orifice P and two adjusting-orifices, A A, all being beveled to an angle of forty-five degrees. Fig. 5 is a transverse section of the protractor-limb, including the frame, the graduated arc, and clamp for the same, at the dotted lines *d d*, Fig. 1. Fig. 6 is a section of the central part of the T-head at the dotted line *d''*, showing the manner of adjusting, at exactly right angles, the T-arm T A by the action of the adjusting-nuts A N A N against the two tongues of said arm T' T', the tongue T of said head having a pivoted attachment to the T-arm by means of the pivot-nut T P N, Figs. 1 and 8. Fig. 7 is a transverse section of the protractor-arm at the dotted line *d'*, showing the vernier-plate V P, protractor-arm P A, screws Sc Sc, which are permanently attached to the former, and the adjusting-nuts A N A N, showing the manner in which they act against the outer side of the beveled adjusting-orifices A A, Figs. 1 and 4, of the protractor-arm. This adjustment is, in all respects, similar to that shown in Fig. 6; and its object is to bring the protractor-arm nicely at right angles with the face of the base when its vernier is set at O. Fig. 8 is a longitudinal section of the T through its central line, drawn by mistake in an inverted position. Fig. 9 presents, at full size, that portion of the T adjacent to the spring for the purpose of showing its shape and bearing, the tongues above it being represented as cut away for this object.

The protractor frame or base P F, Figs. 1, 2, is a plate of brass or German silver about one-seventh of an inch thick. Sl is a circular slot in the frame, of one hundred and eighty degrees length, extending ninety degrees to the right and left of the 0 or central point. In this slot slides the depressed part of the graduated limb or circle C, being nicely fitted thereto. This part, depressed by half the thickness of the frame, as seen in Fig. 2, is a little less than ninety degrees long; and near its two extremities are permanently inserted the two clamp-screws, through which the dotted lines *d d*, Fig. 1, pass, clearly shown in Fig. 5. Hence, when the graduated arc is unclamped it may be slid either to the right or left forty-five degrees, or any amount less which the operation on hand may require. This facility renders the instrument far more convenient and extended in its applications, with

results more reliable and a great saving of time. D is a circular depression in the central part of the frame, of half its thickness, V P, Fig. 2, for the playing of the vernier-plate. Into an orifice in its center, as seen in the same figure, is soldered the socket-piece S P for receiving the main pivot M P, the former being made of brass and the latter of bronze, or vice versa, nicely fitted to each other. The vernier-plate V P, Figs. 2, 3, consists of a plate of soft steel about one-fourteenth of an inch thick, Fig. 2, of the length, breadth, and shape shown in Fig. 3. To this is attached, by means of the fixed nut F N, the vernier V, Figs. 1, 2, made of German silver, of the length, breadth, form, and thickness shown in the latter figures. This attachment is further secured by means of the fixed nut F N, Figs. 1, 2, 3, which is screwed into the vernier-plate, forming also an internal screw for the main clamp-screw M C S, Fig. 2. The addition of the clamp-piece C P, corresponding in shape laterally with the vernier, which lies directly above it, but extending farther toward the main pivot, completes the clamp. Into the orifices P A A, Fig. 3, are permanently inserted iron or steel screws for receiving the pivot-nut P N, Fig. 2, and two adjusting-nuts at A A, Figs. 1 and 4, in all respects like A N A N, Fig. 6. The socket of the vernier-plate Soc, Fig. 3, is nicely fitted to the main pivot M P, Fig. 2; and these, with the protractor-frame, are all held in their normal position by means of the nut N, Figs. 1, 2. The protractor-arm P A, Figs. 1, 2, 4, consists of a steel plate, with saw temper, about one-fourteenth of an inch thick, one and one-half inch wide, and of two feet length, more or less, according to the specific use of the instrument. It is attached to the vernier-plate by means of the pivot-nut and two adjusting-nuts, referred to above, the adjusting-orifices A A being placed, for the purpose of adjustment, about one-fiftieth of an inch nearer together than the corresponding screws in the vernier-plate at A A, Fig. 3. By this arrangement, in the first place, the arm may be instantly removed and exchanged for another of different length; and, secondly, it can be readily and with great nicety adjusted with an accompanying wrench. Fig. 7 shows the precise arrangement and operation of the adjusting-nuts, those of the protractor-arm and of the T-arm being identical in principle, though different in form. Figs. 1, 6, 8, 9 show the precise construction and arrangement of the sliding T, including the arm T A, head T H, tongues T and T′ T′, pivot-nut T P N, spring-nut S N, spring S, and adjusting-nuts A N A N. The T-head and arm are made of soft steel, of the same thickness with the protractor-arm; and the head is held in constant and close contact with the latter arm by means of the spring S. The T is easily reversed, and, in bringing it into position on either side of the protractor-arm, the thumb and forefinger are placed upon the pivot and spring-nuts, while the latter is pressed toward the former, and thus held until the T rests upon the paper.

In connection with this trigonometer thus constituted may be used, for laying down or measuring distances on paper, the original "scale-plate," patented May 15, 1860, the "micrometer scale," patented June 16, 1863, the "improved drafting-scale," patented February 7, 1865, the "scale-dividers," patented February 21, 1871, and some of the other scales now in use, though the last two named are by far the most convenient.

For small work, the sliding T is not required, a rectangular drafting-board with metallic adjustable borders being used instead; but, for all large or extended work, it is indispensable. A single metallic bar, one-eighth of an inch thick, one and one-half to two inches wide, and about four feet in length, may be attached to one border of the board, (depressed for the purpose,) and shifted from one position to another as fast as the work on the paper is completed, for an unlimited distance; and, if two bars on the opposite borders of the board are used, a breadth of six feet or more may be conveniently given to the paper; while, by the arrangement above shown for shifting the position of the graduated limb, any desired side of the drawing may be made parallel or at right angles with the board. Thus all angles to a minute of a degree, and all distances to the thousandth of an inch, may be laid down or measured; and this may be done even more conveniently with the sliding T than with the drafting-board referred to above, having an adjustable metallic border.

I claim—

The combination, as shown, of a sliding T with the trigonometer, including the head, spring and connecting-plate, for the purposes set forth.

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